

WHAT IS CLAIMED IS:

1. A thin-film magnetic head comprising:

a lower core layer formed so as to extend in a height  
5 direction from a surface opposing a recording medium;

a magnetic layer connected to the lower core layer  
directly or indirectly at a position spaced from the opposing  
surface in the height direction by a predetermined distance;  
and

10 a coil layer toroidally winding around the magnetic  
layer,

wherein the toroidal coil layer is connected to a  
plurality of first coil pieces formed between the lower core  
layer and the magnetic layer and a plurality of second coil  
15 pieces formed on the magnetic layer, and

wherein the upper surfaces of the first coil pieces are  
covered with an insulating layer other than connection  
surfaces to the second coil pieces, the connection surfaces  
of the first coil pieces being raised upward and exposed from  
20 the upper surface of the insulating layer so that the second  
coil pieces are formed in contact with the connection  
surfaces of the first coil pieces.

2. A head according to Claim 1, further comprising a  
25 raised layer provided on the lower core layer at a position  
spaced in a track width direction from the center of the  
lower core layer in the track width direction,

wherein part of the first coil pieces is mounted on the

raised layer, part of the upper surfaces of the first coil pieces being exposed from the upper surface of the insulating layer at the position on that the first coil pieces mount, so that the exposed surface becomes the connecting surface.

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3. A head according to Claim 2, wherein the upper surface of the raised layer is a flattening surface, and at least part of the first coil pieces mounted on the flattening surface becomes the connecting surface.

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4. A head according to Claim 3, wherein the first coil pieces are formed partway the flattening surface.

5. A head according to Claim 2, wherein the upper  
15 surface of the raised layer is a curved surface, and part of the first coil pieces mounted on the curved surface becomes the connecting surface.

6. A head according to Claim 5, wherein the first coil  
20 pieces are formed partway the curved surface.

7. A head according to Claim 1, wherein the upper surface of the insulating layer and the connection surfaces of the first coil pieces are an identical flattening surface.  
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8. A head according to Claim 2, wherein the raised layer intersects under a plurality of the first coil pieces.

9. A head according to Claim 2, wherein the raised layer is arranged under each of the first coil pieces.

10. A head according to Claim 1, wherein on the lower core layer, a lower magnetic polar layer, a gap layer, and an upper magnetic polar layer, which is the magnetic layer, are deposited in that order from beneath so as to form a deposited structure, and a track width  $T_w$  is determined by the width of the deposited structure on the opposing surface in a track width direction.

11. A head according to Claim 1, wherein on the lower core layer, at least a lower magnetic polar layer, a gap layer formed of a non-magnetic metallic material, and an upper magnetic polar layer are plated in that order from beneath so as to form a magnetic-polar tip layer with a track width  $T_w$  defined by a width of an end face adjacent to an opposing surface to a recording medium in a track width direction, and on the magnetic-polar tip layer, the magnetic layer is deposited.

12. A head according to Claim 11, wherein the saturated magnetic induction density of the magnetic layer is lower than that of the upper magnetic polar layer.

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13. A head according to Claim 1, wherein the length of the second coil pieces in a first direction perpendicular to the flowing direction of an electric current is larger than

that of the first coil pieces in the first direction.

14. A head according to Claim 1, wherein the film thickness of the second coil pieces is larger than that of the first coil pieces.

15. A manufacturing method of a thin film magnetic head comprising the steps of:

- (a) forming a lower core layer so as to extend in a height direction from a surface opposing a recording medium;
- (b) forming a raised layer on the lower core layer at a position spaced in a track width direction from the center of the lower core layer in the track width direction,
- (c) forming a plurality of first coil pieces ranging from on the lower core layer to on the raised layer with separations in the height direction;
- (d) forming a coil insulating layer between the first coil pieces and on the first coil pieces;
- (f) scraping the upper surface of the coil insulating layer so as to form a flattening surface while exposing part of the first coil pieces formed on the upper surface of the raised layer from the upper surface of the coil insulating layer; and
- (g) forming a magnetic layer on the coil insulating layer, and then forming a plurality of the second coil pieces on the magnetic layer while forming a toroidal layer composed of the first coil pieces and the second coil pieces by directly bringing an end portion of the second coil pieces

into contact with the exposure surface formed on the first coil pieces.

16. A method according to Claim 15, wherein in the step  
5 (b), the upper surface of the raised layer is formed to be the flattening surface and in the step (f), part of the first coil pieces mounted on the flattening surface is polished to be the exposure surface.

10 17. A method according to Claim 16, wherein in the step (b), the first coil pieces are formed partway the flattening surface.

18. A method according to Claim 15, wherein in the step  
15 (b), the upper surface of the raised layer is formed to be a curved surface and in the step (f), part of the first coil pieces mounted on the curved surface is polished to be the exposure surface.

20 19. A method according to Claim 18, wherein in the step (b), the first coil pieces are formed partway the curved surface.

20. A method according to Claim 15, wherein in the step  
25 (f), the upper surface of the coil insulating layer and the exposure surface formed in the first coil pieces are formed to be the same flattening surface.

21. A method according to Claim 20, wherein in the step (f), the insulating layer and the exposure surface are formed to be the same flattening surface by CMP.

5        22. A method according to Claim 15, wherein in the step (c), the raised layer intersects under a plurality of the first coil pieces and in the step (b), the raised layer is formed in a band shape.

10       23. A method according to Claim 15, wherein in the step (c), the raised layer is formed under each of the first coil pieces and in the step (b), the raised layer is decoupled.